

NAME: _____

Score: _____ / + 20
Chemistry 312
Final Review**FINAL EXAM**
Review Problems

1. Name the following molecules.

a. H_2SO_4 Sulfuric acidc. AgCl Silver Chlorideb. CuNO_3 Copper I nitrated. Ca(OH)_2 Calcium hydroxide

2. Write the formulas for the following compounds.

a. hydrofluoric acid HFc. ammonium phosphate $(\text{NH}_4)_3\text{PO}_4$ b. iron (III) oxide Fe_2O_3 d. aluminum chloride AlCl_3

3. Balance and identify the type of reaction for the following.

a. _____ I_2 + _____ 2 NaF \rightarrow _____ 2 NaI + _____ F_2 b. _____ KOH + _____ AgNO_3 \rightarrow _____ KNO_3 + _____ AgOH c. _____ C_3H_8 + _____ 5 O_2 \rightarrow _____ 3 CO_2 + _____ $\text{4 H}_2\text{O}$ d. _____ 3 H_2 + _____ N_2 \rightarrow _____ 2 NH_3 e. _____ $(\text{NH}_4)_2\text{SO}_4$ \rightarrow _____ 2 NH_3 + _____ H_2SO_4 (single replacement)
~~This actually does not occur~~
Double replacement
Combustion
Synthesis
Decomposition

4. Predict the products and then balance the equations.

a. _____ CH_4 + _____ 2 O_2 \rightarrow _____ CO_2 + _____ $\text{2 H}_2\text{O}$ b. _____ Al + _____ $\text{Pb(NO}_3)_3$ \rightarrow _____ Pb + _____ $\text{Al(NO}_3)_3$ c. _____ Ca(OH)_2 + _____ 2 HCl \rightarrow _____ CaCl_2 + _____ $\text{2 H}_2\text{O}$ Remember $\text{HOH} = \text{H}_2\text{O}$ d. _____ PbO_2 \rightarrow _____ Pb + _____ O_2 e. _____ 2 Na + _____ Cl_2 \rightarrow _____ 2 NaCl

5. Will any of the above reactions form a precipitate? If so, which ones?

NO.

6. Will the following reactions occur?

a. $\text{Cl}_2 + \text{LiI}$ \rightarrow $\text{LiCl} + \text{I}_2$ yes (not balanced)b. $\text{Ag} + \text{Cu(NO}_3)_2$ \rightarrow NR (silver is lower in the activity series than copper) \rightarrow By definition a precipitate is a solid that arises when two aqueous solutions are combined.

7. Calculate the number of molecules in 87 grams of hydrochloric acid.

$$87\text{g HCl} \left(\frac{1\text{mole}}{36.5\text{g}} \right) \left(\frac{6.02 \times 10^{23}\text{ molecules}}{1\text{mol}} \right) =$$

 1.4×10^{24} molecules HCl8. Calculate the number of grams of KClO_3 in 1.26×10^{27} molecules of the compound.

$$1.26 \times 10^{27}\text{ molecules} \left(\frac{1\text{mol}}{6.02 \times 10^{23}\text{ molecules}} \right) \left(\frac{122.6\text{g}}{1\text{mol}} \right) =$$

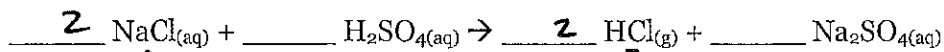
 $2.57 \times 10^5\text{g KClO}_3$

9. Calculate the number of moles in 49.98 grams of Bohrium.

$$49.98g \text{ Bh} \left(\frac{1 \text{ mol}}{262g} \right) = 0.19 \text{ mol Bh}$$

0.19 mol Bh

10. Balance the equation and then use the reaction to answer the following questions.

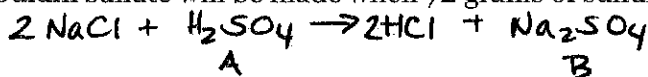


a. How many moles of hydrochloric acid would be produced if 3.65 moles of sodium chloride are used up?

$$3.65 \text{ mol A} \left(\frac{2 \text{ mol B}}{2 \text{ mol A}} \right) = 3.65 \text{ mol B (HCl)}$$

3.65 mol HCl

b. How many grams of sodium sulfate will be made when 72 grams of sulfuric acid react with an excess of sodium chloride?



$$72g \text{ A} \left(\frac{1 \text{ mol A}}{98.1g} \right) \left(\frac{1 \text{ mol B}}{1 \text{ mol A}} \right) \left(\frac{142.1g}{1 \text{ mol B}} \right) = 104g \text{ Na}_2\text{SO}_4$$

104g Na₂SO₄

c. Determine the limiting reactant when 112 grams of sodium chloride react with 203 grams of sulfuric acid.

$$112g \text{ NaCl} \left(\frac{1 \text{ mol}}{58.5g} \right) = 1.9 \text{ moles}$$

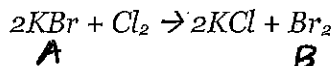
$$203g \text{ H}_2\text{SO}_4 \left(\frac{1 \text{ mol}}{98.1g} \right) = 2.1 \text{ moles}$$

$$1.12g \text{ NaCl} \left(\frac{1 \text{ mol}}{58.5} \right) \left(\frac{2 \text{ mol HCl}}{2 \text{ mol NaCl}} \right) = 1.9 \text{ mol HCl}$$

$$203g \text{ H}_2\text{SO}_4 \left(\frac{1 \text{ mol}}{98.1g} \right) \left(\frac{2 \text{ mol HCl}}{1 \text{ mol H}_2\text{SO}_4} \right) = 4.1 \text{ mol HCl}$$

1.12g NaCl yields the smaller amount of product.

11. Determine the percent yield in the reaction if one starts with 20 grams of potassium bromide and produces 5 grams of bromine gas.



$$20g \text{ KBr} \left(\frac{1 \text{ mol}}{119g \text{ KBr}} \right) \left(\frac{1 \text{ mol B}}{2 \text{ mol A}} \right) \left(\frac{159.8g}{1 \text{ mol B}} \right) = 13.4g$$

$$\frac{5}{13.4} \times 100 =$$

37 %

12. Which diffuses at a faster rate: SO_2 or NO_2 ? What is the ratio of diffusion rates?

NO_2 is faster because of its smaller molar mass

$$\begin{array}{l} \text{SO}_2 = B \\ \text{NO}_2 = A \end{array} \quad \frac{\text{ratio of NO}_2}{\text{ratio of SO}_2} = \sqrt{\frac{64.1g}{46g}} = 1.18$$

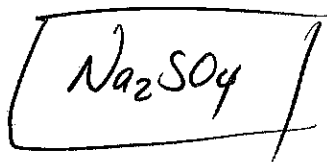
NO_2 diffuses 1.18 times faster than SO_2

13. Determine the empirical formula for a compound with 36.5% Na, 25.4% S, and 38.1% O.

$$36.5g \text{ Na} \left(\frac{1 \text{ mol}}{23g} \right) = \frac{1.587 \text{ mol Na}}{0.7913} = 2$$

$$25.4g \text{ S} \left(\frac{1 \text{ mol}}{32.1g} \right) = \frac{0.7913 \text{ mol S}}{0.7913} = 1$$

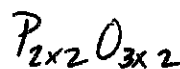
$$38.1g \text{ O} \left(\frac{1 \text{ mol}}{16g} \right) = \frac{2.381 \text{ mol O}}{0.7913} = 4$$



14. Determine the molecular formula for a compound consisting of 56.4% P and 43.6% O with a molar mass of 220 g/mol.

$$56.4g \text{ P} \left(\frac{1 \text{ mol}}{31g} \right) = \frac{1.819 \text{ mol P}}{1.819} = 1 \text{ mol P} \times 2 = 2 \quad \text{P}_2\text{O}_3 = 110g$$

$$43.6g \text{ O} \left(\frac{1 \text{ mol}}{16g} \right) = \frac{2.725 \text{ mol O}}{1.819} = 1.5 \text{ mol O} \times 2 = 3 \quad \frac{220}{110} = 2$$



15. Use Boyle's, Charles's, or Gay-Lussac's law to calculate the missing value in each.

a.

$$V_1 = 3.1 \text{ L}$$

$$P_1 = ?$$

$$V_2 = 6.7 \text{ L}$$

$$P_2 = 2.04 \text{ atm}$$

$$P_1 V_1 = P_2 V_2$$

$$P_1 = \frac{P_2 V_2}{V_1}$$

$$(2.04 \text{ atm})(6.7 \text{ L}) \left(\frac{1}{3.1 \text{ L}} \right) =$$

$$\boxed{4.4 \text{ atm}}$$

b.

$$V_1 = 873 \text{ mL}$$

$$T_1 = 365 \text{ K}$$

$$V_2 = ?$$

$$T_2 = 345 \text{ K}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$V_2 = \frac{V_1 T_2}{T_1}$$

$$873 \text{ mL} \left(\frac{345 \text{ K}}{365 \text{ K}} \right) =$$

$$\boxed{825 \text{ mL}}$$

c.

$$T_1 = 210 \text{ K}$$

$$P_1 = 101 \text{ kPa}$$

$$T_2 = ?$$

$$P_2 = 215 \text{ kPa}$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \quad T_2 = \frac{P_2 T_1}{P_1} = \frac{(215 \text{ kPa})(210 \text{ K})}{(101 \text{ kPa})}$$

$$447 \text{ K}$$

16. A balloon will burst at a volume of 2.0 L. If the gas in a partially filled balloon occupies 0.75 L at a temperature of 21°C, and a pressure of 990 kPa, what is the temperature at which it will burst if the pressure is 1010 kPa at the time it breaks?

$$P_1 = 990 \text{ kPa} \quad V_1 = 0.75 \text{ L} \quad T_1 = 294 \text{ K} \quad P_2 = 1010 \text{ kPa} \quad V_2 = 2.0 \text{ L}$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \quad T_2 = \frac{P_2 V_2 T_1}{P_1 V_1} = \frac{(1010 \text{ kPa})(2.0 \text{ L})(294 \text{ K})}{(990 \text{ kPa})(0.75 \text{ L})}$$

$$799.8 \text{ K}$$

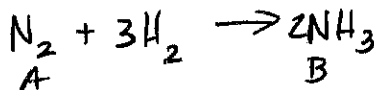
17. Calculate the volume a gas will occupy under the following conditions: 3.00 mol H_2 at 24°C and 0.98 atm.

$$PV = nRT$$

$$V = \frac{nRT}{P}$$

$$(3.0 \text{ mol}) \left(\frac{0.0821 \text{ L} \cdot \text{atm}}{\text{K} \cdot \text{mol}} \right) \left(\frac{297 \text{ K}}{1} \right) \left(\frac{1}{0.98} \right) = 74.6 \text{ L}$$

18. If 50 L of nitrogen are used with excess hydrogen to produce ammonia (NH_3), what volume of ammonia is formed at STP? At 63 kPa and 32°C?



$$\text{At STP } 50 \text{ L}_\text{A} \left(\frac{1 \text{ mol}_\text{A}}{22.4 \text{ L}} \right) \left(\frac{2 \text{ mol}_\text{B}}{1 \text{ mol}_\text{A}} \right) \left(\frac{22.4 \text{ L}}{1 \text{ mol}} \right) = 100 \text{ L}$$

$$PV = nRT \quad V = \frac{nRT}{P}$$

$$100 \text{ L @ STP}$$

You can't do this one because you don't have moles.

19. Chlorine has a molar mass of 70.9 g/mol. What is its density at STP? What is its density at 0.87 atm and 27°C?

$$D = \frac{m}{V} \quad \frac{70.9 \text{ g}}{\text{mol}} \times \frac{1 \text{ mol}}{22.4 \text{ L}} = 3.17 \text{ g/L}$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \quad V_2 = \frac{P_1 V_1 T_2}{T_1 P_2} = \frac{(1 \text{ atm})(22.4 \text{ L})(300 \text{ K})}{(273 \text{ K})(0.87 \text{ atm})}$$

$$\frac{70 \text{ g}}{\text{mol}} \times \frac{1 \text{ mol}}{28.3} = 2.5 \quad 3.17 \text{ g @ STP} \quad 2.5 \text{ g/L}$$

20. Calculate the partial pressure of water vapor if the total pressure is 720 mmHg, nitrogen is 560 mmHg, and oxygen is 155 mmHg.

$$P_T = P_{\text{N}_2} + P_{\text{O}_2} + P_{\text{H}_2\text{O}}$$

$$720 \text{ mmHg} = 560 \text{ mmHg} + 155 \text{ mmHg} + X$$

$$5 \text{ mmHg}$$

21. Convert the following pressures.

a. 4.5 atm to psi

$$4.5 \text{ atm} \left(\frac{14.7 \text{ psi}}{1 \text{ atm}} \right) = 66.15 \text{ psi}$$

b. 167 kPa to mmHg

$$167 \text{ kPa} \left(\frac{760 \text{ mmHg}}{101.3 \text{ kPa}} \right)$$

$$1253 \text{ mmHg.}$$